Energy Conservation in California Energy Commission Demand Forecast Models

Energy Commission demand forecasts seek to account for all conservation that is "reasonably expected to occur." Since the 1985 *Electricity Report*, conservation programs that are reasonably expected to occur have been split into two types: committed and uncommitted. This demand forecast continues that distinction. “Committed” programs are defined as programs that have been implemented or for which funding has been approved. While “conservation reasonably expected to occur” includes both committed and uncommitted programs, only the effects of committed programs are included in the demand forecast. The uncommitted demand side management (DSM) forecast of load impacts from programs or other actions is treated as a resource to allow comparison of DSM to other resource options. Long-term “stretch” goals for a series of programs that are not funded are considered uncommitted.

A difficulty arises in correctly projecting uncommitted impacts versus market effects, standards effect, and savings from public or utility programs that are captured in forecast models. Building and appliance standards are modeled within the residential and commercial forecast models. The models account for building decay, equipment replacement, and market-induced impacts. Some DSM programs sponsored by utilities, state government, local government, and other organizations are also modeled within the sector models. In addition, as models are calibrated to historical actual data, they implicitly account for the effects of many years of energy efficiency programs. Therefore, the forecasts may include some impacts associated with the historical and ongoing levels of programs to the extent they represent impacts associated with replacement of aging building stock and equipment or installation of new stock and equipment at efficiency levels that comply with current building and appliance standards. “Uncommitted effects” are thus defined as the incremental impacts of the level of future programs (for example, savings associated with new equipment that exceeds current standards or early replacement of existing stock), impacts of new programs, and impacts from expansion of current programs.

At the July 10, 2007, workshop, several utilities articulated the need to better understand the conservation embedded in the Energy Commission’s forecast to avoid including in resource plans uncommitted savings that are already accounted for in the forecast. To address this issue, staff prepared estimates of conservation impacts for each utility planning area.

Attribution of savings from standards is guided by the principle that program savings are determined in the reverse order of introduction. This chronological sequencing approach requires that a series of model runs be made. For example, the effects of the 2005 building standards were calculated by comparing energy use with those standards in effect (the baseline forecast) to what energy use would have been under the prevailing

1998 building standards. The difference between the baseline forecast and a model run with the 2005 standards removed is the impact attributed to the 2005 standards. Similarly, the effect of the 1998 standards was calculated by comparing the energy use of buildings that comply with the standards to the prevailing practice before their implementation. When all building and appliance standards are removed, only market or price effects remain. Finally, prices are held constant from 1977 forward, producing an estimate of demand with no standards or price effects.

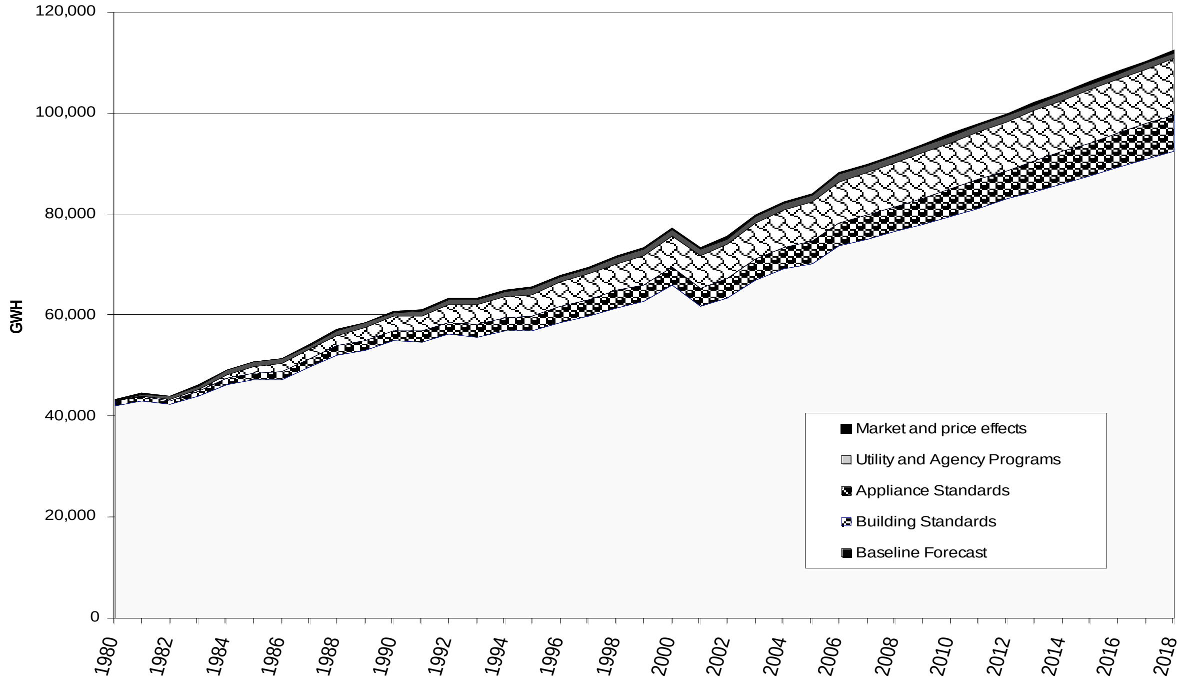
A significant complication of implementing this convention is the attribution of savings to market forces, including direct consumer price response. Because the models runs which are used to quantify the effects of standards use fuel price assumptions from the baseline forecast, the estimated savings are conditional upon the market savings, which depend upon the fuel price assumptions of the baseline forecast. Changes in such fuel price assumptions, all other effects held constant, change the savings quantified for each program. High fuel prices lead to lower program savings and lower fuel prices lead to higher program savings.

The impacts from many utilities' and government programs are also estimated directly within the end-use models. However, because of the large number of programs and the extreme difficulty in attributing impacts to particular programs, no attempt is made to attribute impacts through an iterative process. Estimated savings by program are obtained directly from utilities and public agencies. At the aggregate, the utility and program estimates are used to gauge the impacts included within the end use models.

Estimates of impacts calculated outside the sector models are the product of a three step process. First, first-year impacts are assigned a useful measure life. Second, a degradation factor is applied to each year of the useful life to account for poor maintenance or equipment failure. Third, the final results are aggregated and provided to the summary model where they are used to evaluate the sector forecasts. Explicit adjustments are made only to those programs whose effects are not likely to be captured by other model effects.

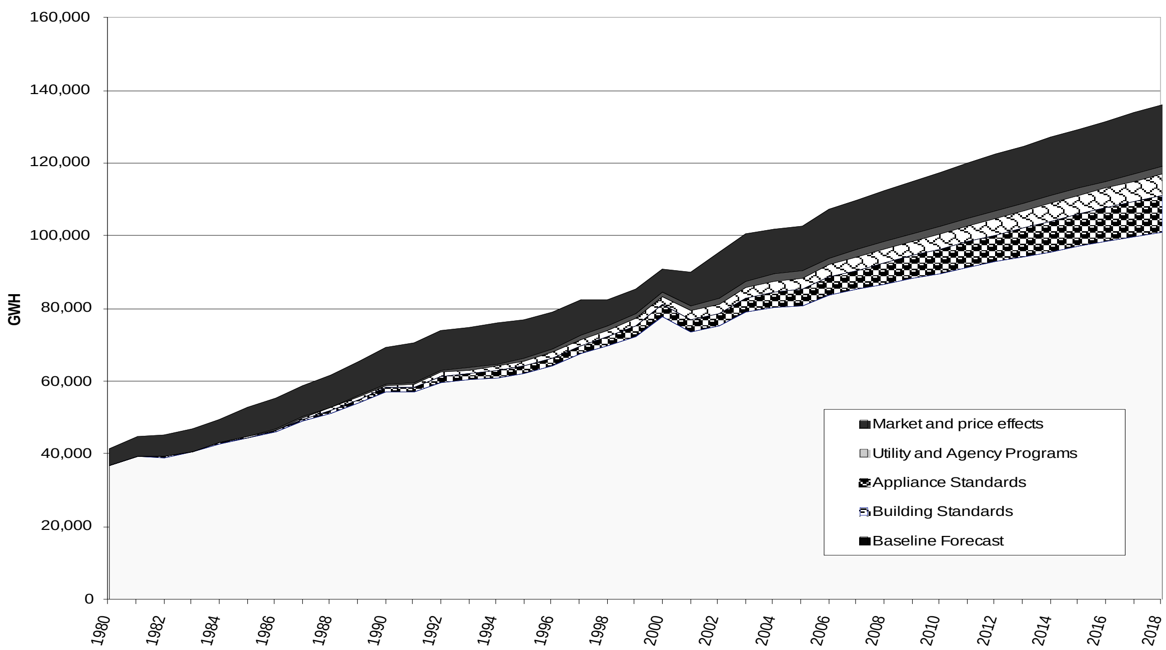
Figures 9 and 10 illustrate the commercial and residential results for the three IOUs combined. The bottom area represents the staff-revised demand forecast. Each area above the forecast represents the savings from that category—the amount by which it is estimated consumption would have increased if those requirements were eliminated. For example, the estimated impacts of residential building standards are over 7,000 GWH by 2018, meaning elimination of the standards from the residential forecast model increased projected consumption by that amount. The upper line represents estimated consumption when all standards and programs are removed from the model and electricity prices are held constant. Because of greater price elasticity, market effects are more significant in the commercial sector.

Figure 9: Estimated IOU Residential Consumption and Conservation Impacts (GWH)



Source: California Energy Commission, 2007.

Figure 10: Estimated IOU Commercial Consumption and Conservation Impacts (GWH)



Source: California Energy Commission, 2007.

Table 6 summarizes the estimated residential and commercial conservation impacts for selected years for the three IOUs: PG&E, Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E). Results for each utility can found in the planning area chapter. Tables presenting these impacts in more detail can be found in Appendix A.

Table 6: Estimates of Commercial and Residential Conservation Impacts for PG&E, SCE, and SDG&E

	Residential Energy Savings (GWH)				Commercial Energy Savings (GWH)				
	Building & Appliance Standards	Utility and Public Agency Programs	Market and Price Effects	Total	Building & Appliance Standards	Utility and Public Agency Programs	Market and Price Effects	Total	Total Energy Savings
1990	5,740	994	253	6,987	2,499	398	12,109	15,006	21,993
2000	11,650	1,308	413	13,371	6,736	1,358	8,259	16,353	29,724
2005	14,615	1,416	447	16,478	9,572	1,987	13,724	25,283	41,761
2008	16,336	1,355	458	18,149	11,682	2,132	15,420	29,234	47,383
2013	18,977	1,256	476	20,709	15,563	2,094	17,135	34,792	55,501
2018	21,533	1,186	497	23,216	19,608	2,052	18,447	40,108	63,323
	Residential Peak Savings (MW)				**Commercial Peak Savings (MW)**				
	Building & Appliance Standards	**Utility and Public Agency Programs**	**Market and Price Effects**	**Total**	**Building & Appliance Standards**	**Utility and Public Agency Programs**	**Market and Price Effects**	**Total**	**Total Peak Savings**
1990	1,717	325	56	2,099	460	62	2,303	2,825	4,924
2000	3,066	426	92	3,584	1,279	256	1,409	2,943	6,527
2005	3,772	501	100	4,373	1,807	378	2,846	5,032	9,405
2008	4,121	489	102	4,713	2,195	406	3,248	5,849	10,562
2013	4,677	451	106	5,235	2,928	399	3,610	6,937	12,171
2018	5,277	425	111	5,814	3,697	391	3,899	7,986	13,800

Source: California Energy Commission, 2007.

These results represent impacts only in the residential and commercial sectors, about two-thirds of total consumption. The Energy Commission's industrial, agriculture, and other sector forecasts do not model conservation effects explicitly. In these models the forecast is driven by econometric or other statistical analysis of historical energy intensity trends. All conservation impacts through the last historical year are by definition accounted for, and the projected trends incorporate effects of past energy efficiency programs on usage, as well as price or market effects. The industrial sector overall has shown large decreases in energy intensity in many industries that far exceed utility estimates of program savings for that sector.

Investor-Owned Utility Energy Efficiency Goals for 2006-2008

In decision D.04-09-060, the CPUC established numerical goals for electricity and natural gas savings for the IOUs for the period 2004–2013.[1] D.04-09-060 implements a

[1] California Public Utilities Commission, *Interim Opinion: Energy Savings Goals for Program Year 2006 and Beyond*, D. 04-09-040, September 23, 2004, in Energy Efficiency Rulemaking 01-08-028.

core component of the *Energy Action Plan*, which was earlier adopted by the CPUC, the California Energy Commission, and the California Consumer Power and Conservation Financing Authority. The decision translated that mandate into explicit, numerical goals for reducing electricity and natural gas consumption as well as peak demand. Savings from energy efficiency programs funded by the public goods charge and procurement rates will contribute to these goals, including those achieved through the Low-Income Efficiency Program. Committed conservation programs are those programs included in the 2006–2008 program plans approved in the CPUC Energy Efficiency Rulemaking Proceeding (R04-06-010) or in other CPUC decisions, and therefore explicit adjustments are made only for those programs.

To account for these goals in the forecast, staff used the impacts by sector or program category provided by each utility in its *2007 IEPR* demand forecast submittal. The electricity program savings goals used for each IOU are shown in **Table 7**. The planned programs and estimated impacts are evaluated, and only the effects of those programs that are not already captured in the models are included in the forecast. The resulting forecast of efficiency impacts was then used to adjust the raw residential and commercial demand forecasts.

Table 7: First Year Impacts of 2004–2008 Energy Efficiency Goals

	PG&E		**SCE**		**SDG&E**	
	GWh	MW	GWh	MW	GWh	MW
2004	744	161	826	179	268	58
2005	744	161	826	179	268	58
2006	829	180	922	200	281	61
2007	944	205	1046	227	285	62
2008	1053	229	1167	253	284	62

Source: Utility demand forecast submittals to the California Energy Commission, 2007.

Investor-Owned Utility Energy Efficiency Goals for 2009 and Beyond

Because the post-2008 IOU program strategies are under development, they are not explicitly accounted for in this forecast. However, staff's assessment is that historically many of the effects of utility programs are indirectly accounted for in the models. For the programs implemented in 2006-2008, staff estimates that approximately 80 to 90 percent of the expected impacts are reflected in the models in other ways; the remainder is accounted for through direct adjustments. This assessment of significant overlap is specific to the 2006-2008 program mix which heavily targets end-uses also affected by codes and standards (such as refrigerators and commercial lighting). If the current program mix and level of effectiveness is unchanged, this level of overlap would be expected to continue in future years.

There are two important reasons why the explicit adjustment to the forecast is so small. First, much of this overlap is associated with effects that in staff's assessment are captured by other model assumptions. So the impacts are real, but they are attributed to standards, not programs. For example, in staff's commercial forecasting model, lighting intensity in large offices declines by 10 percent between 2009 and 2013 as standards are applied to buildings being replaced or retrofit. The current IOU program mix also emphasizes commercial lighting. In reality, lighting systems may be retrofit before the building reaches the model decay threshold, but this effect is not represented in staff's models. Also, the CPUC allows credit toward the goals of codes and standards compliance efforts by the IOUs. Finally, the process of calibration to historical data adjusts the forecast for actual impacts without attribution to any specific program or standard.

The second reason relates to projected program savings versus the actual net change in total consumption. Historically, verified program impacts have been found to be significantly less than projected program savings. Therefore, if actual utility savings have been, for example, 70 percent of planned savings, the forecast is calibrated to a trend with that lower level of impact (that is, a higher energy intensity trend), and the forecast assumes a similar trend for the future. If future programs are more effective, that will be an incremental reduction to the forecast. (This would also mean less cost-effective potential has been achieved, and therefore more remains available for the future). Futhermore, the net observed reduction in consumption may be reduced by offsetting behavior changes or incorrect assumptions about usage characteristics.

These overlaps would be expected to continue for post-2008 program expenditures, unless the post-2008 program designs change in substantial ways, for example by devising programs emphasizing measures that produce effects that are not captured currently within the forecasting models. The direction laid out in the October 18, 2007, CPUC decision[2] indicates a significant change of direction, targeting, for example, new construction and air conditioning rather than lighting. This change in program mix would translate to a greater explicit impact on the staff forecast. Also, the new structure of financial risks and rewards for IOUs presented in the CPUC's September 20, 2007, decision[3] could increase program effectiveness above historical levels. Also, future program strategies may place a greater emphasis on total long-term savings as opposed to near-term annual impacts, in which case the current annual targets are not a good indicator of the pattern of future savings.

The overlap between staff forecast assumptions and currently uncommitted program effects is likely to decrease in the post-2008 period but cannot be appropriately assessed until specific program plans are developed. Users of the forecast can assume it includes a level of future impacts consistent with the current program mix and effectiveness. As 2009-2011 program plans are developed and approved, staff will evaluate them and quantify appropriate adjustments to the forecast.

The use of Energy Commission forecasts in IOU procurement plans present several challenges. First, since the IOUs do not develop the forecasts, they have less insight into model characteristics. Second, the IOUs are directed to use targets developed

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[2] California Public Utilities Commission, *Interim Order on Issues Relating To Future Savings Goals And Program Planning For 2009-2011 Energy Efficiency And Beyond*, October 18, 2007.
[3] California Public Utilities Commission, *Interim Opinion On Phase 1 Issues: Shareholder Risk/Reward Incentive MechanismFor Energy Efficiency Programs D.07-09-043*, September 20, 2007.

several years ago. While the targets are valuable as a tool for directing policy, they do not correspond well to a forecast done in 2007. The analysis behind the targets did not account for 2005 building standards and used an Energy Commission forecast with different model assumptions (for example, lower saturations of air conditioning.) The CPUC declines to modify the targets at this time (except possibly for SDG&E's), suggesting that other energy efficiency opportunities are likely to have arisen to offset the decrease in potential now captured by standards. So the targets no longer embody a specific set of efficiency measures that can be compared to forecast assumptions. Third, the mandated approach of subtracting 100 percent of the targets from the demand forecast contrasts with Energy Commission approach of forecasting expected impacts. These issues can be addressed in part by staff providing the necessary analysis to identify the appropriate adjustment for a given energy efficiency program portfolio. Use of portfolio risk analysis can also account for the uncertainty of projected load impacts.